

WHAT IS CLAIMED IS:

1 1. An alloy carbon steel comprising iron and a maximum of 0.35% by
2 weight of carbon, said alloy carbon steel having a triple-phase microstructure comprising
3 ferrite crystals fused with martensite-austenite crystals, said martensite-austenite crystals
4 comprising laths of martensite alternating with thin films of austenite.

1 2. An alloy carbon steel in accordance with claim 1 in which said
2 martensite-austenite crystals are devoid of carbide precipitates at interfaces between
3 phases.

1 3. An alloy carbon steel in accordance with claim 1 in which
2 martensite-austenite crystals constitute from about 5% to about 95% by weight of said
3 triple-phase microstructure.

1 4. An alloy carbon steel in accordance with claim 1 in which said
2 martensite-austenite crystals constitute from about 15% to about 60% by weight of said
3 triple-phase microstructure.

1 5. An alloy carbon steel in accordance with claim 1 in which said
2 martensite-austenite crystals constitute from about 20% to about 40% by weight of said
3 triple-phase microstructure.

1 6. An alloy carbon steel in accordance with claim 1 in which said
2 carbon constitutes from about 0.01% to about 0.35% by weight of said triple-phase
3 microstructure.

1 7. An alloy carbon steel in accordance with claim 1 in which said
2 carbon constitutes from about 0.03% to about 0.3% by weight of said triple-phase
3 microstructure.

1 8. An alloy carbon steel in accordance with claim 1 in which said
2 carbon constitutes from about 0.05% to about 0.2% by weight of said triple-phase
3 microstructure.

1 **9.** An alloy carbon steel in accordance with claim **1** further
2 comprising silicon at a concentration of from about 0.1% to about 3% by weight of said
3 alloy composition.

1 **10.** An alloy carbon steel in accordance with claim **1** further
2 comprising silicon at a concentration of from about 1% to about 2.5% by weight of said
3 alloy composition.

1 **11.** An alloy carbon steel in accordance with claim **1** in which said
2 carbon constitutes from about 0.03% to about 0.3% by weight of said triple-phase
3 microstructure, said alloy carbon steel further comprising silicon at a concentration of
4 from about 0.1% to about 3% by weight of said alloy composition.

1 **12.** An alloy carbon steel in accordance with claim **1** in which said
2 carbon constitutes from about 0.05% to about 0.2% by weight of said triple-phase
3 microstructure, said alloy carbon steel further comprising silicon at a concentration of
4 from about 1% to about 2.5% by weight of said alloy composition, and containing
5 substantially no carbides.

1 **13.** A process for manufacturing a high-strength, corrosion-resistant
2 tough alloy carbon steel, said process comprising:

- 3 (a) forming an alloy composition comprising iron and at least one
4 alloying element comprising a maximum of about 0.35% by weight
5 of carbon in proportions selected to provide said alloy composition
6 with a martensite transition range having a martensite start
7 temperature of at least about 300°C;
8 (b) heating said alloy composition to a temperature sufficiently high to
9 cause austenitization thereof, under conditions causing said alloy
10 composition to assume a homogeneous austenite phase with all
11 alloying elements in solution;
12 (c) cooling said homogeneous austenite phase sufficiently to transform
13 a portion of said austenite phase to ferrite crystals, thereby forming
14 a two-phase microstructure comprising ferrite crystals fused with
15 austenite crystals; and

16 (d) cooling said two-phase microstructure through said martensite
17 transition range under conditions causing conversion of said
18 austenite crystals to a microstructure containing laths of martensite
19 alternating with films of retained austenite.

1 14. A process in accordance with claim 13 in which step (d) comprises
2 cooling said two-phase microstructure at a rate sufficiently fast to avoid the occurrence of
3 autotempering.

1 15. A process in accordance with claim 13 in which step (d) comprises
2 cooling said two-phase microstructure by contact of said two-phase crystal structure with
3 water.

1 16. A process in accordance with claim 13 in which step (c) comprises
2 cooling said homogeneous austenite phase to a temperature of from about 750°C to about
3 950°C.

1 17. A process in accordance with claim 13 in which step (c) comprises
2 cooling said homogeneous austenite phase to a temperature of from about 775°C to about
3 900°C.

1 18. A process in accordance with claim 13 in which said carbon
2 constitutes from about 0.01% to about 0.35% by weight of said alloy composition.

1 19. A process in accordance with claim 13 in which said carbon
2 constitutes from about 0.03% to about 0.3% by weight of said alloy composition.

1 20. A process in accordance with claim 13 in which said carbon
2 constitutes from about 0.05% to about 0.2% by weight of said alloy composition.

1 21. A process in accordance with claim 13 in which said alloy
2 composition further comprises silicon at a concentration of from about 0.1% to about 3%
3 by weight.

1 22. A process in accordance with claim 13 in which said alloy
2 composition further comprises silicon at a concentration of from about 1% to about 2.5%
3 by weight.